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Concerning some West American Fungi

By David Griffiths

This writing is intended to supplement the information supplied on some conventional herbarium labels recently distributed, and to call attention more in detail to certain species which appear to the author to have hitherto escaped the attention of mycologists. All species described are being liberally distributed so that the determinations may be easily verified.

Tilletia externa sp. nov.

Fructification of fungus occurring between the seed coats of the ovary where a black powdery mass of spores is formed surrounding the entire ovary, in some cases, but always more abundantly developed on the upper half, and often not appearing on the lower half at all. Spores black in mass, dark fuscous when viewed singly by transmitted light, very variable in size and shape, subglobose to elliptical, or irregular and angular, 10–13 μ x 18–23 μ or the subglobose spores 17–21 μ in diameter, the contents granular ; epispore thin, smooth, surrounded by a hyaline envelope 2–2½ μ in thickness. (Fig. 1.)

Affecting ovaries of *Carex filifolia* Nutt. (305) * on Burnett's Ranch near Buffalo, Wyo., Aug. 1898 (Williams & Griffiths). The fungus was especially abundant and destructive in this locality on high dry knolls at an altitude of about 4000 feet.

Tilletia Earlei sp. nov.

Fungus producing its spores usually in the next to the upper internode of the culm, transforming the parenchymatous tissue within and between the vascular bundles into a light brown powdery mass of spores which finally ruptures the tissue between the bundles producing long fissures a centimeter to a decimeter in length, the edges of the fissure recurving so as to expose and distribute the mass of spores; culms usually much swollen and otherwise distorted and separated from the sheath. Spores light brown in mass but only very slightly tinted when viewed singly, globose, evenly covered with very coarse tubercles and surrounded by a hyaline envelope about 2 μ thick; epispore rather thin but often appearing thick on account of the tubercles, 13–18 μ in diameter. (Fig. 2.)

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* All figures used in this manner refer to the serial numbers of West American Fungi.

Affecting the culms of *Agropyron occidentale* Scribn. (311), Aberdeen, S. D., August 10, 1896. The host grew on ground heavily fertilized with refuse from the city on high and dry banks of the Moccasin a short distance below the mouth of a sewer. The species is easily recognized by its method of attack as well as by its color which is more like that of some of the species of *Sorosporium* which affect the Compositae. It was very destructive to the host during 1896, '97 and '98 in this very circumscribed area of not over an acre in extent. There were square rods where the host grew to the exclusion of almost all else, having every culm

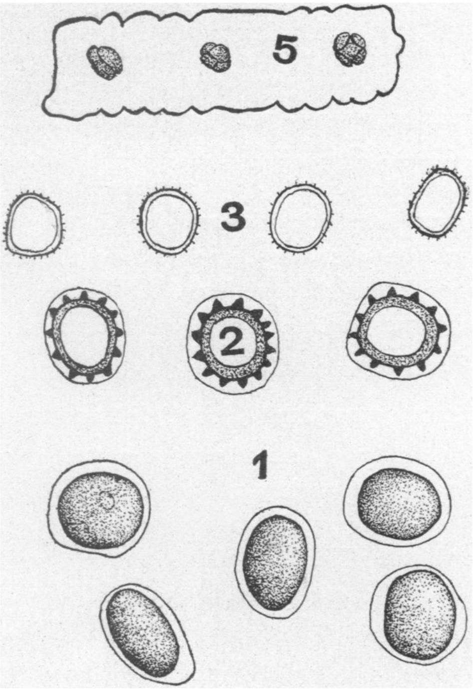


FIG. 1. Spores of *Tilletia externa*. × 630.
FIG, 2. Spores of *Tilletia Earlei*. × 630.
FIG. 3. Spores of *Ustilago elegans*. × 630.
FIG. 5. Spores of *Sorosporium Williamsii*, and outline of the cylindrical spore mass. × 730.

affected and no seed whatever produced. During five years' collecting it was observed in no other locality, although the host is one of the most common of the prairie grasses and often found in similar situations.

Ustilago elegans sp. nov.

Fructification of fungus occurring within the upper or within the second or third leaf sheath which becomes much enlarged and does not open until the maturity of the parasite which occupies its entire interior. Spores subglobose, angular or often elongated with a small central rather indistinct nucleus, 10–13 μ in diameter; epispore about 1 μ thick, minutely echinulate. (Fig. 3.)

On *Chloris elegans* H.B.K. (309) Cochise, Ariz., Oct. 1900. The method of attack, while similar in all cases studied in the field, presents a great variation which is coördinated with the vigor of the plant. On the general mesa the plants affected with the smut were not usually over one to two and one half inches tall with all but the lower internodes destroyed. In the railroad ditches, however, where the host was stimulated by the accumulation of water, the upper internode together with the head was ordinarily affected. Sometimes both of these methods of attack are to be found in the same plant.

USTILAGO HYPODYTES (Schw.) Fr. and its allies

These culm smuts are exceedingly abundant in many portions of the West on a great variety of hosts. My collections contain them on the following: *Stipa spartea* Trin. (3), *Stipa viridula* Trin., *Stipa occidentale* Thurb. (236), *Agropyron occidentale* Scribn. (234), *Elymus condensatus* Presl. (233), *Elymus striatus* Willd. (201), *Distichlis spicata* (L.) Greene (235). The first of these, collected at Canton, S. D., is referred to *U. minima* Arth. the others to *U. hypodytes* although the author is inclined to the opinion that future cultural and inoculation experiments will result in a segregation of species. Field observations in the Northwest during the past ten years point strongly to such a conclusion. One of the above forms may often be found attacking every individual of a certain species within certain areas while other hosts upon which some of the forms occur may within the same area be entirely unaffected. Notable instances of this have been observed in several localities. At Brookings, S. D., in 1892, 1893 and again in 1896 *Stipa viridula* was almost completely prevented from making seed in a certain locality while *Agropyron occidentale* in actual contact with it was entirely unaffected. In 1896 and 1897 at Aberdeen, S. D., the same grasses were observed growing together, but in this instance the *Agropyron* was smutted while the *Stipa* was entirely free. In the vicinity of Billings, Mont., in 1900 smutted plants of *Elymus striatus* and *Agropyron occidentale* were both growing with *Stipa viridula* in different situations, but the latter was entirely unaffected. During the past summer *Elymus condensatus* was very badly smutted at Quinn River Crossing, Nev. *Distichlis spicata* growing about its base was entirely unaffected. In another locality in the same general region where the hosts bore the same relation to each other *Distichlis* was badly smutted while *Elymus* was perfectly free from the disease. In one locality, near Andrews, Oregon, they were both found smutted growing side by side.

There are slight differences in spore characters in some of these forms, but they are too slight to warrant the establishment of species upon them. The spores of the forms on *Stipa occidentale* are a trifle larger than any of the others while the form on *Distichlis* has spores with somewhat thicker walls and more restricted central area. The form on *Agropyron occidentale* from Billings, Mont., has the epispore much darker than any of the others. These differences are trifling of course, but when emphasized by the above field observations their importance is magnified very much. It might be added that these differences are fully as great as those which led to the establishment of *U. funalis* E. & E. on *Eriocoma cuspidata.*

USTILAGO MINOR Norton

This species is very abundant and destructive all through southern Arizona. There appears to be in my material a slight difference in the size of the spores of all collections of *Bouteloua oligostachya* whether from Montana or Arizona. All collections on this host are, therefore, referred to *U. filifera* Nort. (217 and 217*a*). *U. minor*, as represented in my collections from Arizona, occurs on *Bouteloua polystachya* (220), *B. aristidoides* (218), *B. eriopoda* (219), *B. bromoides* (227), and *Pappophorum Wrightii* (224). It is very destructive to all of these species and may be commonly found anywhere from the high mountains to the river bottoms. Its method of attack and the extent of injury done are very variable and apparently correlated with the vigor of the host which is dependent in turn upon the supply of moisture and the fertility of the soil. On fertile soil so situated as to receive an abundance of moisture in the vicinity of Cochise, plants of *B. polystachya* with scarcely a leaf or node unsmutted were but little if any reduced in size; but plants of the same species growing on sandy land near Wilcox were reduced to a small rosette of pustules on the surface of the ground, not over three fourths of an inch in diameter, while the length of culm here averaged about five inches. Similar differences were observable in its method of attack when growing on *Bouteloua aristidoides* in the Santa Cruz valley near Tucson.

USTILAGO MULFORDIANA E. & E. AND TILLETIA FUSCA E. & E.

It is strange that these two species have not found their way into herbaria more abundantly than they have, for there are no fungi more plentiful in many portions of Montana, Wyoming, Idaho and Oregon than these two species. The writer has also collected the former in the Santa Rita Mountains in southern Arizona.

It is also rather strange that the two species should be so commonly associated in the Northwest. They have been seen associated together at Sheridan, Wyo., Billings, Missoula and Kalispell, Mont., and Ontario, Ore. At both Billings and Missoula an abundance of plants were found affected by both species. They invariably, of course, select different culms for their fructification. The first species destroys the upper portion of the culm within the enlarged leaf sheath. The latter allows an apparently normal development of all portions of the host except the ovary which is very much enlarged. The host of both species is *Festuca octoflora* Walt. Professor F. S. Earle has compared some of my material with the type of *U. Mulfordiana* in the herbarium of the New York Botanical Garden and reports that the hosts also appear to be the same.

USTILAGO ARISTIDAE Peck

This species is very destructive to *Aristida Schiedeana* in Arizona, where it has been observed in several localities, but always on the same host. Examination of herbarium specimens of the grass shows that the fungus is widely distributed throughout the Southwest. Its persistently tectate condition is very noticeable in all the specimens examined. The author made a large collection (214) in the Santa Catalina Mountains, in Arizona, in Nov. 1900. In the following April, when the locality was visited again, the fungus (214*a*) appeared to be as perfectly preserved as it was five months before. Large herbarium specimens of the host have been seen with every seed destroyed by the smut, but notwithstanding the vast amount of handling, none of them were ruptured.

Professor Norton reports that the fungus causes a shortening of the awns of *Aristida purpurea* in Kansas. Such is not the case with the host mentioned above for there is apparently no modification of any portion of the plant except the ovary.

Sorosporium bigeloviæ sp. nov.

Fungus attacking and destroying the inflorescence especially, but involving also the bracts and often the upper leaves of the branches. The florets become transformed into a globular mass filled with light brown spores and surrounded by a thin pellicle consisting of the modified involucral covering. The leaves become very much swollen especially near the base, the whole interior being transformed into a mass of spores. Spore masses very variable, elongated globular or polygonal and containing 2–6 spores (usually only 3 or 4) commonly 13–21 μ in diameter but often as high as 25–30 μ. Spores globular, globose or compressed and polygonal, 7–10 μ in diameter; epispore thick, distinctly tuberculate and of light straw color. (Fig. 4.)

On *Bigelovia* (399) Tucson, Arizona, Nov., 1900. This was the most common fungus to be found in the Santa Cruse valley near Tucson during the fall and winter of 1900. But, while this is true, it is very likely to be overlooked because the attack of the smut is not at all conspicuous. In one locality north of the city a dense growth of the host along a fence row for a distance of at least ten rods produced almost no seed. Some plants had nearly all the flower heads formed but destroyed, while others had their growth arrested by the abundant fructification of the fungus in the bases of the upper leaves.

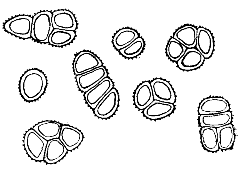


FIG. 4. Spores of *Sorosporium bigeloviæ*. × 115.

Sorosporium Williamsii sp. nov.

Fungus producing its spores in the peripheral tissues of the culm of the host within the leaf sheath, transforming them into a black powdery mass and preventing the fructification of the host, the upper node being usually but little developed; two to four nodes are commonly involved; spore mass very loosely united, containing many spores, cylindrical, straight or curved, 65–100 μ x 20–30 μ, scarcely distinguishable at maturity; spores fuscous, subglobose or angular, 5–7 μ in diameter; epispore comparatively thin, smooth, but fissured by a few deep grooves which in optical section often appear to divide it into four approximately equal segments. (Fig. 5.)

Attacking the sheathed culms of *Stipa Richardsonii* Link. (306), Big Horn Mts., Wyo., August 12, 1896 (T. A. Williams & David Griffiths). The species has been collected but once, but it was very abundant and destructive in this place, a large pine clearing at an altitude of about 8000 feet on one of the tributaries of the North Fork of Clear Creek. In habit and gross appearance it is identical with *U. hypodytes* and *U. minima.* The markings of the spores, however, readily separate it from these species even in the over-ripe condition when the spore masses have been broken up.

Gymnoconia riddelliae sp. nov.

Spermogonia hypophyllous, scattered, prominent, honey-yellow, abundant, producing globular hyaline sporidia 2–3 μ in diameter. Aecidia amphigenous, but more abundant below, scattered, circular, oval, or irregular and often confluent over large areas, lilac-purple turning to light brown when dry; spores globular to slightly ovate, 7–8 μ in diameter, epispore smooth and thin. Uredosori amphigenous but more numerous below, circular, small, 0.5 mm. in diameter, long covered by the unruptured epidermis which forms minute whitish spots not noticeable except under a lens; uredospores subglobose or angular and often broadly ovate, 26–29 μ x 20–24 μ, light brown when mature, the epispore thick, finely and evenly tuberculate; teleutospores produced in the same sori as the uredospores and appearing about the time that the epidermis ruptures, the two being mixed for some time, but as the teleutospores develop the sori become enlarged, black and very conspicuous; teleutospores cuneate to elliptical, 38–50 μ x 20–24 μ, broadly rounded or pointed above and conspicuously constricted at the septum, epispore smooth, strongly thickened above, the pedicel hyaline, quite persistent, two to three times the length of the spore. (Fig. 6.)

On leaves and stems of *Riddellia Cooperi* Gray (378, 378*a* and 378*b*), Tucson, Arizona, Nov. 1900. This is a very common species with an interesting distribution. It may be collected at almost any season of the year, but is most conspicuous during the rainy season when the host is in a vigorous growing condition. It is found in situations where the host receives the most moisture and the writer has never collected it on the dryer portions of the mesas. On the contrary, he has seen it usually in shallow washes which receive the drainage waters from higher altitudes. It was especially conspicuous during 1900 and 1901 on the government range reserve at the mouth of a culvert under the railroad. The aecidial stage was abundant here in autumn and spring.

Specimens of this species from the collections of Professor Toumey are to be found in some herbaria under *Puccinia tanaceti* DC.

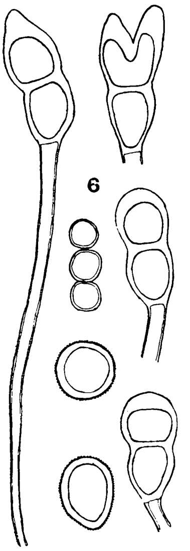


FIG. 6. Æcidiospores, uredospores and teleutospores of *Gymnoconia riddelliae*. All magnified 315 except the aecidiospores which are magnified 500.

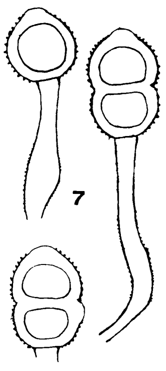


FIG. 7. Teleutospores of *Puccinia bouvardiae*. ×315.

Puccinia bouvardiae sp. nov.

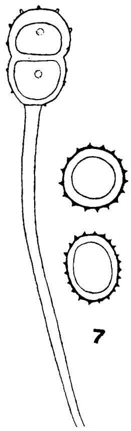
Teleutosori mostly epiphyllous but often found below also, circular, scattered, prominent, black and ragged under a lens, the remains of the ruptured epidermis which is at first prominent soon disappearing; teleutospores broadly elliptical, rounded below, with a yellowish umbonate apiculum above, and often a similar projection on the lower cell immediately below the septum, slightly constricted at the septum, 23–28 μ x 36–46 μ; epispore very thick, dark brown, tuberculate; pedicel broad, hyaline, persistent, crooked, one and a half to two and a half times the length of the spore, roughened and commonly enlarged below the middle. (Fig. 7.)

On *Bouvardia triphylla* Salisb. (394), Santa Catalina Mts., Ariz., Nov. 1900. Apparently not a common species. This is probably the other stage of *Aecideum bouvardiae* D. & H. Associated with it on the same leaves are the remains of a few old aecidia whose spores correspond very well with that species. The aecidial stage is altogether too old however for one to decide with certainty.

Puccinia Burnettii sp. nov.

Persistently epiphyllous, with very large, scattered, conspicuous sori which often attain a length of 2 cm. and a width equal to that of the leaf, usually causing the edges of the leaf to recurve so as to leave the sorus convex; leaf brown below, the ruptured epidermis prominent but not merely cracking open in the center as usual but being pushed off in large shreds as long as the sorus and often 1–2 mm. in breadth; uredospores subglobose to elliptical or ovate, 20–26 µ in diameter, epispore thick, visibly and evenly tuberculate; teleutospores very uniform, elliptical, very slightly if at all wider above than below, rounded above and below, slightly constricted at the septum, 18–23 µ x 28–31 µ, epispore rather thick, sparsely clothed with short hyaline fugacious projections, very slightly if at all thickened above; pedicel hyaline, 2–4 times the length of the spore. (Fig. 7.)

On *Stipa comata* T. & R. (387), on the Burnett ranch near Buffalo, Wyo., Aug. 1898 (Williams & Griffiths). Later the same season it was collected at Billings, Montana, on the same host. Named for Mr. Burnett who first called my attention to this rust.



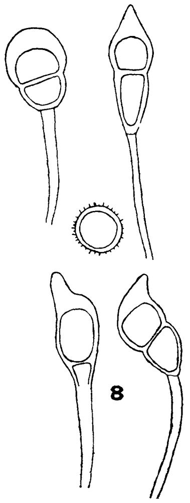


FIG. 7. Uredospores and teleutospore of *Puccinia Burnettii*. × 315.

FIG. 8. Uredospore and teleutospores of *Puccinia micrantha*. × 315.

The species is remarkable for its persistently epiphyllous character and large sori. Even when occurring on the sheaths, as it does very rarely, the sori rupture on the inside and its position is distinguishable by a slight distortion and purplish or brownish coloration on the outside as on the leaf.

Puccinia micrantha sp. nov.

Sori epiphyllous, with both uredo- and teleutospores produced in the same sori which are usually short, linear or circular, scattered evenly over the surface, conspicuous, black, prominent, without visible remains of ruptured epidermis; uredospores subglobose, minutely, rather sparsely but evenly echinulate, 15–17 μ in diameter, the epispore rather thick and prominent in optical section; teleutospores very variable, obovate to oblong-elliptical, very slightly to conspicuously constricted at the septum, the base rounded, the apex broadly rounded or long-pointed, strongly thickened, 13–24 μ × 30–45 μ; pedicel once to twice the length of the spore, hyaline or slightly tinted at the base of the spore. (Fig. 8.)

On living leaves of *Oryzopsis micrantha* (T. & R.) Thurb. (386), Billings, Mont., Sept. 1898 (Williams & Griffiths). This is such a common and familiar species to me that it is with considerable hesitancy that it is given a distinct name. It seems almost impossible that it has not been collected by others; but careful search has not revealed a record of it. It was first collected by Griffiths and Schlosser at Forest City, South Dakota, in 1892 and subsequently in the same locality in 1897 by Griffiths and Carter. Specimens from the first collection are in herbaria of the writer, the agricultural college of South Dakota and the agricultural college of North Dakota. There was also a specimen in the private herbarium of the late Professor T. A. Williams. A large sheaf of the host, all badly rusted, was collected and deposited in the collection of the agricultural college of South Dakota in 1892. It was the intention to have put it up for distribution, but judging from the notes on p. 74 of bulletin no. 40 of that institution it may have been all destroyed except the specimens cited. Professor Bolley, to whom specimens were submitted, reported at the time that the fungus had "characters of its own." Although remembering the specimen, he is unable, owing to removal to new quarters, to find it now.

Aecidium grindeliae sp. nov.

Aecidia usually clustered in brown somewhat thickened areas of the leaf tissue, occurring about equally on both sides of the same spot, each cup forming a distinct papilla having finally a circular or oval or lenticular opening through which the spores escape, the peridium not projecting beyond the raised epidermis of the leaf; aecidiospores globose or angular-compressed, light brown, 20–24 μ in diameter, the epispore thick and very minutely roughened. (Fig. 10.)

On *Grindelia squarrosa* Dunal. (388), Columbia, S. D., June, 1897. This species, although abundant in the locality and on the date mentioned, is apparently rare in the region.

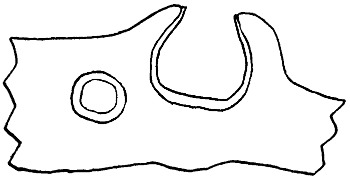


Fig. 10. One spore × 315, and diagram of vertical section of leaf showing outline of cup of *Æcidium Grindeliae*. × 315.

Aecidium Dakotensis sp. nov.

Spermogonia brown or brown-black under a hand lens, yellow by transmitted light, hypophyllous, evenly scattered, very prominent; aecidia hypophyllous and uniformly scattered often over the entire lower surface, the upper surface being marked by small, circular, brown elevations which mark the position of the aecidia below; pseudoperidium very conspicuously lacerated into broad segments which are strongly recurved; aecidiospores globose or compressed-angular, 15–18 μ in diameter, epispore smooth and while not particularly thick is very conspicuous and often thickened at the angles.

On *Aquilegia Canadensis* L. (389), Big Stone Lake, S. D., June, 1895. Apparently a rare species.

Claviceps? caricina sp. nov.

Mycelium of the fungus extending throughout the entire substance of the parenchymatous tissue of the center of the culm of the host, and condensing in one to four places into black, longitudinally-striated sclerotia 1.5–5 mm. x 1–5 cm., the interior of which is white, of uniform density and made up of loosely interwoven, colorless, thick-walled and sparingly septate hyphae.

Invariably associated with the above sclerotia are found, in upper portion of the culm, elongated black sori which rupture the epidermis much like a rust and resemble in structure a *Gloeosporium* with hyaline globular spores 1–2 μ in diameter.

On *Carex Nebraskensis* Dewey, Andrews, Ore., Aug. 1901 (Griffiths & Morris). Faithful but unsuccessful attempts have been made to cultivate the sclerotia of this interesting species during the past three months. No one realizes better than the writer that the placing of the species in the genus *Claviceps* is a wild guess, but it seems wise to call attention to the fungus in this way that others may look for it.

On the whole the species is very inconspicuous, but when once seen it can be readily detected afterward. The most noticeable character is the rather early death of the culm while the lower leaves are still green; but this is likely at times to be mistaken for the maturing of the plant. The *Gloeosporium* stage is indistinct until late and really does not become noticeable until the sclerotia have disappeared as described below. Usually the sclerotia are formed in the lower half of the culm and fill its entire vertical section; but they may frequently be formed above the middle and even near the head in close proximity to the *Gloeosporium*-like form above. The method of liberation of the sclerotia is very interesting. The culm is killed, and consequently becomes dry, about the time that the sclerotia are mature. In drying, the sclerotia curve into a segment of a circle, thereby rupturing the tissues and falling to the ground. In searching for the cause of the early drying up of the upper portion of the plant it was these ruptures that first attracted my attention and it was only after a long search that the cause was discovered. The external resemblance of the sclerotia to those of *Claviceps purpurea* is very marked.